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TRANSMITTAL FORM

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First Named Inventor	Li, Bin
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ENCLOSURES *(check all that apply)*

☐ Fee Transmittal Form	☐ Assignment Papers *(for an Application)*	☐ After Allowance Communication to Group
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☐ Amendment / Response	☐ Licensing-related Papers	☐ Appeal Communication to Group *(Appeal Notice, Brief, Reply Brief)*
☐ After Final	☐ Petition Routing Slip (PTO/SB/69) and Accompanying Petition	☐ Proprietary Information
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☒ Certified Copy of Priority Document(s) (CA App. No. 2,324,574)	☐ CD, Number of CD(s)	
☐ Response to Missing Parts/ Incomplete Application	Remarks	The Commissioner is authorized to charge any additional fees to Deposit Account 20-1430.
☐ Response to Missing Parts under 37 CFR 1.52 or 1.53		

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Signature	Charles L. Hamilton
Date	May 21, 2002

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This is to certify that the documents attached hereto and identified below are true copies of the documents on file in the Patent Office.

Specification as originally filed, with Application for Patent Serial No: **2,324,574**, on October 26, 2000, by **CATENA NETWORKS CANADA INC.**, assignee of Bin Li, Alberto Ginesi and Song Zhang, for An Optimal Bit Allocation Algorithm for Reed-Solomon Coded Data for ADSL.

S. Grégoire

Agent certificateur/Certifying Officer

February 26, 2002

Date

Canada

(CIPO 68)
01-12-00

OPIC CIPO

AN OPTIMAL BIT ALLOCATION ALGORITHM FOR REED-SOLOMON CODED DATA FOR DSL

BACKGROUND OF INVENTION

It is well known that the performance of an xDSL (digital subscriber line) or more specifically ADSL modem is generally limited by cross-talk. In order to improve the performance, error-correcting codes such as the Reed-Solomon (RS) code is used in ADSL modem signals. The performance improvement not only depends on the RS code parameters such as the code-word length and redundant length, but also depends on the transmission environment such as signal-to-noise ratio distribution over the carriers. For different transmission environments, a best selected RS code, which can maximize the transmission rate, is different to a best selected RS code that can, at the same time, minimize the transmitted power. Furthermore the selection of the best code in either circumstance is also very difficult. The subject invention attempts to mitigate at least one or more of the above disadvantages.

DESCRIPTION OF INVENTION

The present invention provides a bit allocation algorithm for RS coded data. The algorithm will find the best RS code that can maximize the transmitted data rate and minimize the transmitted power. Other constraints such as impulse noise protection and max latency can be added as well.

The bit allocation algorithm is described follows.

1. Pre-calculate the gross coding gain of RS code with different code-word length N (in byte) and parity length R (in byte), and save them in a table or expressed as a mathematical expression such as polynomial expression.

2. Calculate the total number of allocated bits without RS code by

$$b_0 = \sum_{k=1}^{M} \log_2\left(1 + \frac{SNR_k}{\Gamma \cdot \gamma}\right) \qquad (1)$$

where SNR_k is the signal-to-noise ratio for kth sub carrier, Γ is the energy gap associated with QAM transmission and for a given Bit Error Rate (BER), γ is the required margin and finally M is the number of used bins.

3. Initialize the gross coding gain $G = G_{min}$.

4. According to the gross coding gain G, calculate the total number of allocated bits as described in refrence [1]

$$b = \sum_{k=1}^{M} \log_2\left(1 + \frac{SNR_k}{\Gamma \cdot \gamma / G}\right) \qquad (2)$$

5. Find RS codes (in the table obtained in step 1 or the mathematical expression) with such $N = bS$ (where $S \in \{1,2,4,8,16\}$ for ADSL G.lite standard [3]) and R that can provide this gross coding gain or larger. If such code exits, then calculate the information bits $b' = b - R/S$ and restore the parameters (N, R, S, b'). Note that the delay and other requirements such as impulse noise protection can limit the selection of S and R. For example, if protection against an error burst longer than P bytes is desired, the constraint to be used is R*D/2> P [2], where D is the interleaver depth of the inner interleaver associated with the RS code. If a max latency of the system is to be less than Lmax ms, then the constraint to be used is $x + \frac{(S-1)}{4} + \frac{S \cdot D}{4} < L\max$ [3], where x is the constant system delay in ms.

6. Increase G by Δ, and go back to step 4 until G reaches the maximum value G_{max}.

7. Select the parameters (N, R, S, b') which corresponds to the maximum information bits b', compare this number with b_0 to make sure that RS improves the capacity, otherwise do not use RS code.

References:

[1] T.Starr, J.M.Cioffi and P.J.Silverman, Understanding Digital Subscriber Line Technology, Prentice Hall 1999

[2] T.N.Zogakis, P.T.Tong and J.Cioffi, "Performance Comparison of FEC/Interleave Choices with DMT for ADSL", Amati Communications Corp., contribution T1E1.4/93-091

[3] G.992.2 (G.lite): Asymmetrical Digital Subscriber Line (ADSL) Transceiver, ITU, 1999

Claims:

The calculation procedure in the algorithm.

Pre-calculation of gross coding gain of RS code.

Search the RS code through gross coding gain or net coding gain.

Choose the RS code parameters with maximum information bits b'.